



Codes, Standards and Safety

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Energy Efficiency and Renewable Energy

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Reorganization Outcome

- 5 Year Plan

- Comprehensive plan to accelerate C&S activities
 - Identify technologies requiring standards
 - Formulate teams to create standards
 - Develop training programs for building officials, Fire Marshals and regulators
- Comprehensive plan to formalize the safety standards
 - Establish safety goals for technologies and systems.
 - Establish a protocol for all projects that minimize risk
 - Conduct case studieis
- Identify roles and responsibilities



Hydrogen Today

- Production (9 million tons per year)
 - Steam methane reforming
 - Electrolysis
 - Byproduct
- Uses – largely in industrial settings
 - Petroleum upgrading
 - Food processing (hydrogenation)
 - Semiconductor processing
 - NASA (only large-scale fuel use)
- Transporting/Delivery
 - Pipeline
 - Liquid tanker
 - Tube trailer (compressed gas)



Codes and Standards

- Code-making bodies in the US
 - About 20 major developers (excluding federal agencies such as EPA and DOT)
 - Nearly all is done using a consensus process
- Must be adopted by each jurisdiction to be “legal” and binding
 - Approximately 44,000 jurisdictions in the US
 - Federal, state, county, city or town



Code Developers

- International Code Council, Inc. (ICC)
 - Building Officials and Code Administrators International (BOCA)
 - International Conference of Building Officials (ICBO)
 - Southern Building Code Congress International, Inc. (SBCC)
- Underwriters Laboratories (UL)
- National Fire Protection Association (NFPA)
- CSA International
- Society of Automotive Engineers (SAE)
- Institute of Electrical and Electronic Engineers (IEEE)
- American Society of Mechanical Engineers (ASME)
- International Electrotechnical Commission (IEC)
- International Organization for Standards (ISO)
- Compressed Gas Association (CGA)
- Natural Gas Institute (NGI)
- US Department of Transportation
- Occupational Health and Safety Administration (OHSA)



Issues

- Codes & standards are being developed in advance of, or in parallel with, hydrogen-fueled systems
 - Codes & standards development must be coordinated with technology development
 - Efforts should be devoted to R&D efforts to validate proposed standards (i.e., need data to support or validate proposed requirements)
- Coordination is vital
 - All applications involve production, transportation, storage, dispensing, and use of hydrogen
 - A large number of organizations are involved in generating codes & standards



Key Codes

Component Technology	Codes	Status
Production	NFPA 70/ NEC/CEC ASME Boiler-Pressure Vessel Sec. VIII	mature mature
Transportation:	DOT 49 CFR	mature mature
Pipeline	NEC/CEC ANSI/ASME B31.1, B31.8	mature mature
Storage	NFPA 50 A: Gaseous Hydrogen NFPA 50 B: Liquid Hydrogen ASME Boiler-Pressure Vessel Sec. VIII	mature (1961) mature (1961) mature
Vehicle Refueling Stations	HV-3: Hydrogen Vehicle Fuel NFPA 52: CNG Vehicle Fuel HV-1: Hydrogen Vehicle Connector NGV1: NGV connectors	being developed base for HV-3 being developed base for HV-1
Hydrogen Vehicles	HV-3: Hydrogen Vehicle Fuel NFPA 52: CNG Vehicle Fuel HV-2: Gaseous Hydrogen Tanks NGV2: CNG Storage Tanks	being developed base for HV-3 being developed base for HV-2



ISO-TC197

Identification Number	Title	Working Group	Convener (Country)
DIS 13984	Liquid H ₂ - Land Vehicle Fueling System Interface	WG 1	SCC (Canada)
DIS 14687	H ₂ Fuel-Product Specification	WG 3	ANSI (USA)
NP 15594	Airport H ₂ Fueling Facility	WG 4	DIN (Germany)
NP 15866	Gaseous H ₂ and H ₂ Blends-- Vehicular Fuel Systems	WG 5	ANSI (USA)
NP 15869	Gaseous H ₂ - Vehicle fuel tanks	WG 6	ANSI (USA)
NP 15916	Basic requirements for safety of H ₂ systems	WG 7	DIN (Germany)
WD 13985	Liquid H ₂ - Land vehicle fuel tank		SCC (Canada)
WD 13986	Tank containers for multimodal transport of liquid H ₂		SCC (Canada)

Programmatic Status: Codes and Standards



- August 2002
 - Workshop to identify needs
 - 5 Year Plan
- Model Codes
 - Approved Hydrogen in ICC Model Codes
 - Training Program for Code Officials
 - Continuation of Ad Hoc Committee
- Experimental Support





Safe Systems

- Safety can be handled through testing, certification, and engineering, just like with any other fuel: No accident can be justified
- Sustained, collaboration between government and industry
 - Identify parameters required by each participant
 - Funding linked to completing comprehensive safety evaluation: hazops, risk assessment and mitigation plan
 - Information exchange and coordination is key

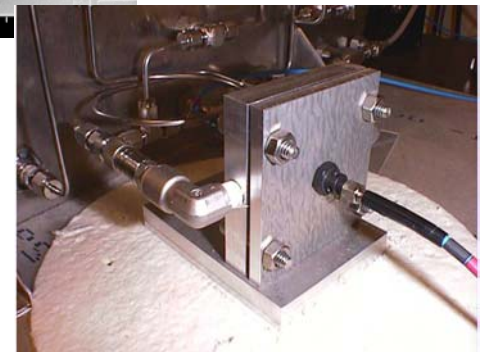
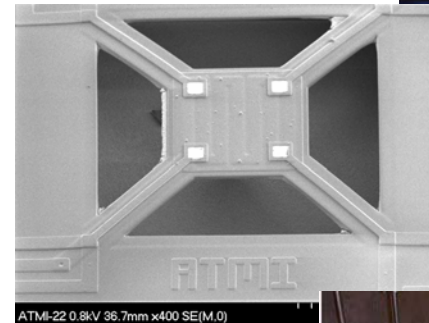
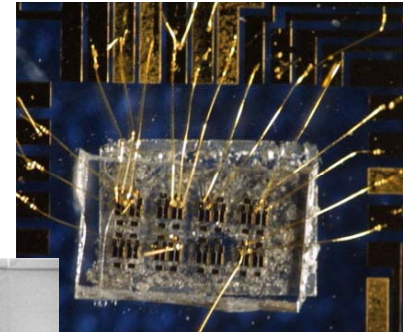
Detection

- Sensors

- Safe, reliable, cheap sensors being developed
- Placement is important

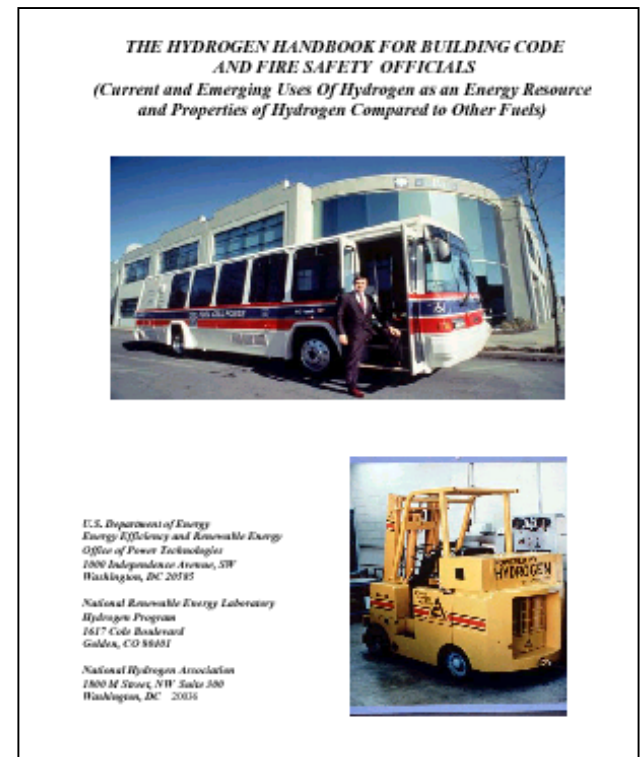
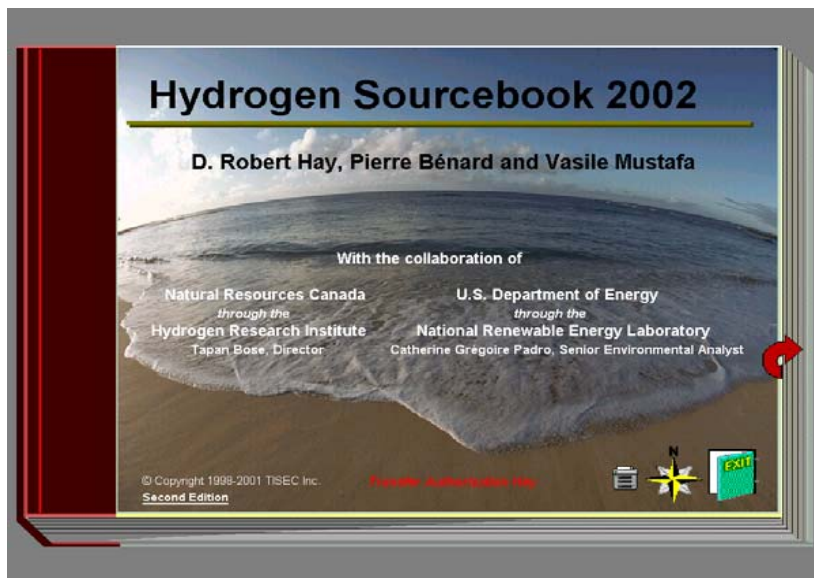
- Odorants

- Diffusion/dispersion matching is difficult
- Poison to fuel cell?



Guidelines for Hydrogen Systems

- The Hydrogen Handbook for Building Code and Fire Safety Officials
- The Hydrogen Sourcebook



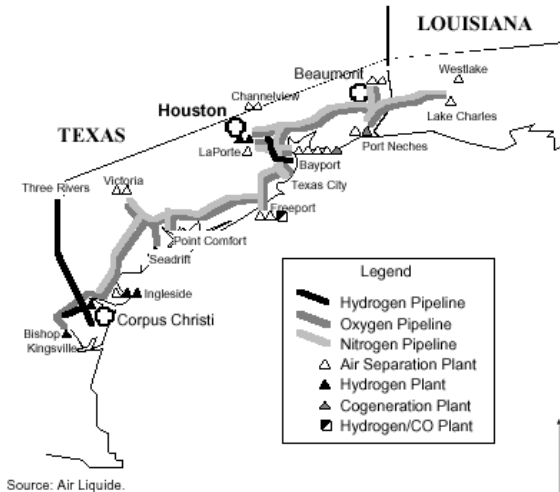


Typical Hydrogen Site Plan Review

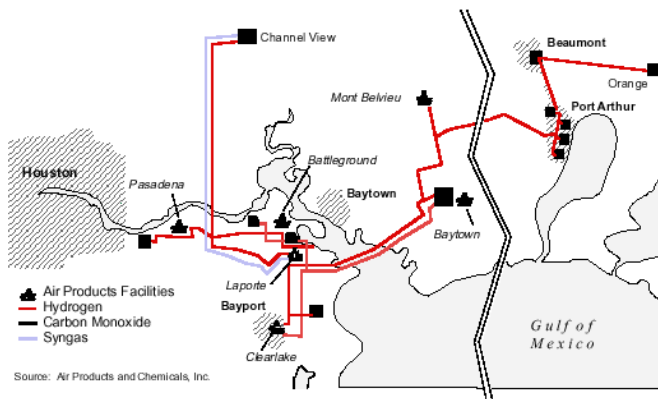
- Confinement
- Review Potential for Ignition
- Minimizing Consequences
- Review the Need for Detectors
- Safety Analysis
- Review Site-Specific Factors
- Personal Investigation

Hydrogen Pipelines

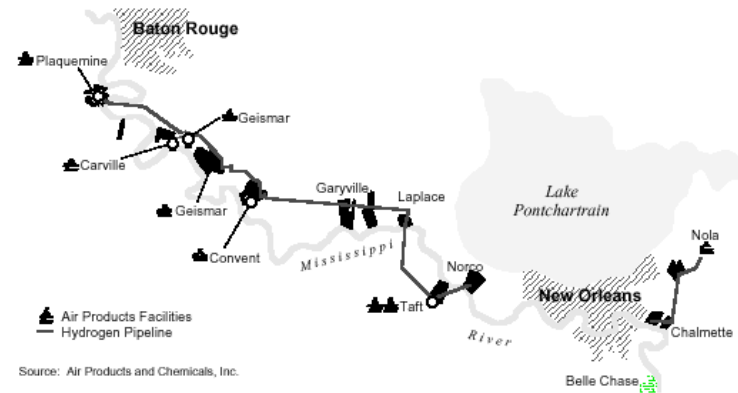
Air Liquide Gulf Coast Pipeline System



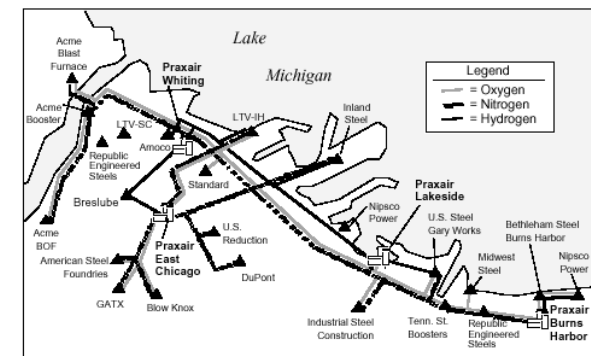
Air Products' U.S. Texas Gulf Coast Hydrogen Pipeline System



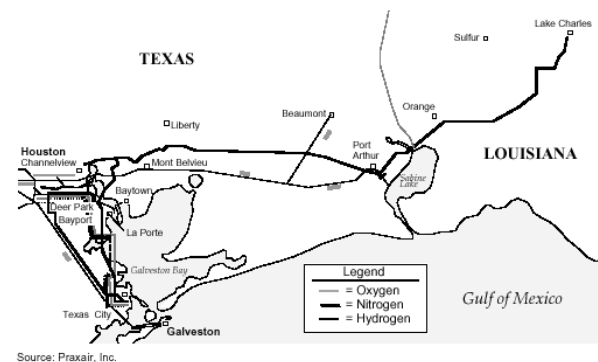
Air Products' Louisiana Hydrogen Pipeline System



Praxair's Chicago Area Pipeline System



Praxair's U.S. Gulf Coast Hydrogen Pipeline System





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